Comet Brooks (November 19, 1892).—The following ephemeris of Comet Brooks is due to Ristenpart, and is given in *Astronomische Nachrichten*, No. 3142:—

1893.	R.A. (app.) h. m. s.	Decl. (app.) ° ′	Log *r*.	Log Δ.	Br.
Jan. 26	23 35 8	+40 34·3	0·0921	0·0471	2·94
27	38 53	39 34·1			
28	42 22	38 36·8	0·0950	0·0688	2·62
29	45 37	37 42·2			
30	48 40	36 50·2	0·0981	0·0898	2·35
31	51 32	36 0·5			
Feb. 1	54 14	35 13·1	0·1015	0·1101	2·11
2	23 56 48	34 27·7			

This comet, which will be found to be in the constellation of Andromeda, will lie about 3½° to the south of *i* Andromedæ on January 27.

Photographic Absorption of our Atmosphere.—The question of the degree with which our atmosphere absorbs photographic rays has become very important owing to the adoption of photography, so that any work enlightening us on this subject is anxiously listened to. Prof. Schaeberle, who has been making investigations in this direction, has just completed a memoir which is being published by the University of California, but in the meanwhile he has issued a table setting forth simply the final results. The absorption in the following table is expressed in photographic magnitudes, and must be added to the unknown atmospheric absorption at the zenith.

Z. D. °	Phot. Absorp.	Z. D. °	Phot. Absorp.
5	0·00	50	0·44
10	0·01	55	0·56
15	0·04	60	0·71
20	0·07	65	0·89
25	0·11	70	1·12
30	0·16	75	1·45
35	0·21	80	1·94
40	0·28	85	2·68
45	0·35	90	5·00

Harvard College Observatory.—The forty-seventh annual report of this Observatory, by Prof. Pickering, opens with a reference to the death of Mr. George B. Clark, to whose "genius for mechanical devices, indomitable perseverance, and devotion to the interests of the observatory, we are indebted for the success of many of our most useful instruments." Of the most important matters mentioned in the report are the permanent establishment of an observing station in South America, where the unsteadiness of the air is for the most part eliminated, the construction of a suitable building for the housing of photographs and the approaching completion of the Bruce photographic telescope. The work done with the various instruments during this period has been considerable. With regard to the Draper telescope, as many as 2777 photographs have been taken, while those taken with the Bache instrument number nearly 2000. The Boyden department, which is situated at Arequipa, in Peru, has been making great progress, the results of which have been frequently inserted in *Astronomy and Astrophysics*. The eight surfaces of the objective of the Bruce telescope have, as Prof. Pickering informs us, been ground and polished, and the results up to the present, according to tests made on a star, are very satisfactory. This instrument, when finished, is destined for the Arequipa station.

Solar Observations at Rome.—Prof. Tacchini has issued the results of the observations made with regard to the distribution in latitude of the solar phenomena at the Royal Observatory during the third semester in 1892. From the tabulated statement which he gives the following facts may be gathered.

With regard to the eruptions, these phenomena seem to be quite local to the equatorial regions, the relative frequency being 0·667 and 0·333 for the north and south latitudes respectively. The spots, faculæ, and eruptions have their maxima nearly at the same distance from the equator both north and south, the zones being (± 20°, ± 30°), but the maxima for the prominences extend further north, about latitudes 60° north and south. Prof. Tacchini remarks that in the equatorial zone (+20°−20°), where the maxima of faculæ, spots, and eruptions are observed, a feeble relative frequency in the prominences is noted, which shows us that we must consider a large number of prominences as the result of conditions "bien différentes par rapport à celles qui déterminent la production des taches dans la photosphère," whilst the prominences are formed simply in the solar atmosphere. As a case in point, he mentions an observation made on August 1 of last year, of a cloud which, starting at a distance of 264″, rose to 364″ without any corresponding alteration at the surface.

The Total Solar Eclipse, April 15–16, 1893.—Writing to M. Flammarion about the scientific expedition sent by the Brazilian Government to study the region of the central plateau and to select a site for the proposed new capital, Dr. Cruls, the Director of the Observatory at Rio de Janeiro, adds the following note:—"About the total eclipse of April 16. Will France send any one to observe it? I beg you to make known through the *Review* (*L'Astronomie*) that the Brazilian Government is willing to send a warship to Ceara, on which foreign astronomers who wished to observe the phenomenon could find a passage."

GEOGRAPHICAL NOTES.

A change has been made in the arrangements for the expedition to Lake Rudolf referred to on p. 235, vol. xlvii. The expedition is to travel by the Tana river instead of the Juba, although its ultimate destination is the same, and Lieutenant Villiers, instead of accompanying it, has joined Sir Gerald Portal's mission to Uganda.

Mr. H. J. Mackinder, M.A., Reader in Geography at Oxford, delivered the first of a course of ten educational lectures, under the auspices of the Royal Geographical Society, on the relation of geography to history, on the 20th inst. The attendance was largely composed of teachers and University Extension students, to whom special terms were offered. The lecturer treated of "the Theatre of History," tracing the development of accurate geographical knowledge from the earliest times in a series of brilliant generalisations. He dwelt upon the contrast between the knowledge of early Greek geographers regarding the true shape of the earth, and their habitual representation of the regions known to them in a circular form. In the middle ages, amongst the half-learned, the map of the known world was elevated to the highest place, the figure of the globe was forgotten, and the doctrine of a flat earth gained currency. At the geographical *renaissance* the map was adapted once more to the sphere, and the discoveries of Columbus and his contemporaries resulted directly.

The suggestion of Mr. Joseph Thomson to bestow the name of Livingstonia (vol. xlvii. p. 160) on the British sphere of influence north of the Zambesi, in spite of its singular propriety, has, we fear, failed to convince the authorities in charge of the region, who, it appears, have decided to adopt the cumbrous and scarcely accurate title of British Central Africa.

M. Mizon's second expedition to Adamawa has been stopped on the Benué by the breakdown of his steamers, and the sudden falling of the water, he being left without means of progress about two-thirds of the way between Lukoja and Yola.

The French flag has been formally hoisted on the little islands of St. Paul and New Amsterdam in the South Indian Ocean, midway between the Cape of Good Hope and Australia. St. Paul is an interesting instance of a volcanic island, the extinct crater of which forms a wide sheltered harbour communicating with the sea by means of a single narrow channel. It was one of the French stations for observing the transit of Venus in 1874. French fishermen from Reunion had practically taken possession of the islands in the early part of the century, but the fishing-grounds have long been abandoned.

Mr. B. V. Darbishire, M.A. (Oxon.), has been appointed Cartographer to the Royal Geographical Society. He has had the advantage of preliminary training in Germany, and under the Reader in Geography at Oxford.

THE APPROACHING ECLIPSE OF THE SUN, APRIL 16, 1893.[1]

I had the honour, two and a half years ago, of describing to you the total eclipse of the sun of December 22, 1889, which I had been to observe in the Salut Isles, French Guiana. In spite of very unfavourable atmospheric conditions I was then able to take some photographs of the phenomena and to measure the actinic intensity of the corona. Two years previously I had been to Russia to observe the eclipse of August 18, 1887, but the bad weather prevented any observations. If these expeditions did not succeed as well as I had hoped, they were at least useful in showing me all the difficulties to be met with in such undertakings, and of convincing me that if one wishes to thoroughly avail one's self of the precious moments during which the eclipse lasts, it is necessary to gain a large experience of these phenomena by omitting no opportunity of observing them, and by making a speciality of these expeditions. Therefore, after the eclipse of 1889 I determined to go to observe the following eclipse, that of the 16th of next April.

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[1] Address to the Astronomical Society of France, on November 2, 1892, by M. De la Baume Pluvinel, translated by A. Taylor.

This time the phenomenon is visible under particularly favourable conditions. On the African coast to the south of Dakar, where the expedition sent by the Bureau des Longitudes will observe, and where I also propose to instal myself, the duration of totality is four minutes thirteen seconds. Moreover, a very important consideration is that we are certain of fine weather. At a time when expeditions are being organised in every country in view of this astronomical event, I think it will be useful to draw your attention to the chief questions which should be the object of astronomical study during the next eclipse.

You are aware that the passing of the moon before the sun has the inestimable advantage of allowing us to see the circumsolar regions which, under ordinary circumstances, because of their faint light are lost in the general illumination of our atmosphere. The regions thus revealed consist of a layer in immediate contact with the sun, the chromosphere, in which are the rosy flames which form the protuberances; and a more or less extensive luminous aureole, the corona. But since the celebrated eclipse of 1868, which marks an epoch in the history of solar physics, we are able, thanks to the great discovery of Messrs. Janssen and Lockyer, to study the protuberances at any time, and consequently it is only to the corona that the attention of astronomers turns during total eclipses.

An invariable part of the day's programme is the study of the structure of the corona, and the luminous intensity of its various parts. We need to have recourse to photography for trustworthy evidence as to this, for photography alone can give a faithful representation of the phenomena; even the best drawings always leave much to be desired. Indeed, it is impossible in the space of a few minutes to exactly represent a nebulous mass as complicated as the corona, and without any definite outlines. We can judge of the difficulty presented by the drawing of the corona, by remembering that even the most skilful draughtsmen have never yet been able to give us similar drawings of the great Orion nebula, although this may be studied at leisure. The brilliancy of the corona varies in intensity so much from one eclipse to another, that it is difficult to determine beforehand the length of exposure needed with given apparatus to obtain as satisfactory a representation of the phenomenon as possible. Moreover, the different parts of the corona differ in brilliancy, so that when the photographic action is sufficient to give a good image of the middle part, the lower portions which form the interior corona are over-exposed, while the extreme limits of the aureole are not reproduced. To satisfy all the conditions it is necessary to take several photographs with different exposures.

To advantageously discuss the results obtained it is very important that astronomers should place upon each plate a uniform scale to measure the intensity of the photographic action upon it. This intensity is equal to the product of three factors; the effectiveness of the object glass, the length of exposure, and the sensitiveness of the plate. If we indicate the useful diameter of the object glass by a and the focus by f, the effectiveness, defined by the international congress of photography, is $100\frac{a^2}{f^2}$. If we take plates of gelatinobromide of silver of normal sensitiveness as our unit, and let t be the length of exposure in seconds, we have the following formula to express the photographic action:—$100\frac{a^2}{f^2}t$. In working with wet collodion plates it is necessary to multiply this expression by $\frac{1}{30}$, and with plates of dry collodion it must be multiplied by $\frac{1}{300}$. The first photographs of the corona, taken with wet collodion, from 1868 to 1878, were obtained with a photographic action not greater than 2. Later, thanks to rapid plates, much greater action could be obtained. Thus in 1883 a photograph obtained by M. Janssen had received a photographic action equal to 918. On the negative thus obtained, the corona extended to between 30′ and 40′ from the limb of the moon, but on the other hand, details of the parts near the sun were completely wanting.

We might ask whether by still further increasing the photographic action we should also extend the limits of the corona? Certainly not! for if the photographic action is too intense, the faint contrast between the extreme parts of the corona and the more or less illuminated sky is no longer appreciable on the negative. We know, indeed, that if we wish to produce the maximum contrast between two half tones we must only use just enough light for the faintest of the half-tones to give a perceptible image. In America, Mr. Burnham has been engaged in determining the maximum length of exposure necessary to obtain the best representation of the corona, and he has made experiments on this subject by photographing the moon and white clouds on a faintly lighted sky.

In 1889, at the Salut Isles, I used five instruments, giving photographic actions varying from 185 to 13, but, doubtless on account of the peculiarly intense illumination of the atmosphere due to the short duration of totality, and the great abundance of water vapour in the atmosphere, the most satisfactory negative was that corresponding to a photographic action of 30. It is very probable that an equally good result might have been obtained with much less photographic action. Mr. Barnard, to whom we owe the best photographs of the eclipse of January 1, 1889, worked with a photographic action equal to 0·58. This result proves that with the sensitive plates now in use it should be possible to obtain good images of the corona on a large scale by using secondary magnifiers to increase the size of the image given by the object glass. In any case we can employ object glasses of two or three metres focal length, which would give images sufficiently large to show all the details of the corona without having resort to enlargement of the plates. Nevertheless, in spite of the use of a long focus, the instrument must remain luminous enough for the time of exposure to be short. The displacements of the image on the plate, caused by the imperfect adjustment of the equatorial mounting, or by an irregularity in the clockwork movement, or by the movement of the sun in declination are thus rendered inappreciable.

The photographs, when obtained, should be examined from the following different points of view. First of all we wish to find if the corona, which will be observed in the month of April, 1893, at a period of great solar activity, and at an epoch when the south pole of the sun is projected on the visible part of its disc, resembles, as we have every reason to think it does, the corona of 1883, which was studied under the same conditions. A great resemblance between the forms of the corona in 1889 and 1878, at the periods of minimum sun-spots, has already been noted, and if it can be established that the corona, seen under similar conditions, presents the same appearance, it will be proved that the diversity of appearance hitherto noticed depends solely upon the state of agitation of the solar surface, and the position of the observer with respect to the solar equator.

If the corona should present an axis of symmetry it must be ascertained whether the poles of this axis coincide with the poles of the axis of rotation of the sun; or if, as is more usually the case, the poles of the corona are inclined at some degrees from the poles of the sun, thus resembling the position of the magnetic poles of the earth with regard to its geographical poles. If the corona shares in the movement of rotation of the sun, it must be the same with its axis of symmetry, and therefore if we once observe the northern pole of the corona to the east of the northern pole of the sun, we ought to find it after an uneven number of half-revolutions, of the sun to the west of the north pole of the sun. To ascertain if this is so or not, it is of the greatest importance to know exactly the orientation of the images upon the photographic plates. The most exact and simple method to orient the images is to place the photographic apparatus in the position which it occupied at the moment of the phenomena, and, in the night, to photograph the trails which the stars leave in passing across the field of the lens.

If the photographs should show the structure of the corona clearly, we shall be able to study the form of those luminous rays which we notice at the poles of the sun, and of those curvilinear structures which seem to extend from the middle latitudes of the sun. The study of the curvature of these structures will be very useful in verifying the exactness of one of the most favoured theories of the corona, which explains the phenomena by supposing that matter is thrown out by the sun normally at its surface, and that its projection is turned on one side by the rotation of the sun. Mr. Schaeberle, of the Lick Observatory, has mathematically studied this theory, and on applying it to eclipses already observed, has been able to report that the curvature of the structures has always conformed with the theory.

We must also examine the photographs taken with the longest exposure, to determine whether the dark parts which sometimes separate the luminous structures, and which we can trace to the base of the corona, are entirely destitute of light. The existence of these *rifts*, as the English call them, is difficult to explain, if we suppose that the coronal atmosphere entirely surrounds the sun, for in that case we should always see, projected on the plane perpendicular to the line of sight, the coronal matter all round the sun. According to Prof. Hastings, the presence of these rifts is a confirmation of his theory which ascribes the corona to diffraction, and not to the existence of a material mass.

Is the aspect of the corona quickly modified, or are the changes which we notice from one eclipse to another effected slowly? Hitherto we have never proved the difference between the photographs of the same eclipse taken at several hours' interval, and at stations very distant from each other. The English astronomers thought of testing this question in December, 1889, and the two English expeditions sent, one to the Salut Isles, and the other to the west coast of Africa, were furnished with photographic outfits as identical as possible, in order to obtain, at an interval of two and a half hours, comparable negatives of the corona. Unfortunately the complete failure of the expedition on the African coast did not permit the carrying out of this programme; otherwise it is very probable they would have proved no sensible difference between the negatives at the two stations, for photographs show that the corona of December 22, 1889, was almost identical with that of January 1 of the same year. We may say, then, that during the year 1889, a year of quietude on the solar surface, the appearance of the corona did not appreciably change.

However, the experiment attempted by the English expeditions needs to be repeated; if not to study the internal movements of the corona, to obtain identical photographs at two different angles, which would enable us, with the aid of the stereoscope, to judge of the *relief* of the corona.

Photographs of a total eclipse will not only inform us as to the structure of the corona, but will permit us to measure its actinic brightness. We can estimate the relative intensity of different parts of the corona by superposing several photographs, made on the same scale, but obtained with very different photographic actions. The outlines of each image would give lines of equal actinic intensity of the corona. The absolute intensity may be measured by comparing the opacity of the image on the plate with the opacities produced on the same plate from a source of standard light. For this purpose the plates destined for photography are previously exposed on their borders to a standard light for varying periods of time. When these plates are developed, a scale of tones which allows a comparison of opacities is obtained at the same time as the image of the phenomena.

The spectroscopic examination of the corona confronts us with still more complex and more interesting problems. When we keep the slit of the spectroscope on the crescent of the sun, which narrows more and more in proportion as the moon advances, the spectrum darkens and the dark lines become less and less apparent; then all at once the field of sight is covered with an infinite number of bright lines, which seem to be substituted for each dark line of the Fraunhofer spectrum. This phenomenon only lasts two or three seconds. Such is the remarkable observation made by Prof. Young in 1870. In the preceding year he had tried to prove this transformation of dark into bright lines, but failed because he had arranged the slit of his spectroscope as a radius to the sun, which gave the bright lines too little length to be perceptible. With a tangential slit, however, the lines were long enough to be easily recognised.

Prof. Young's observations revealed to us the existence round the sun of a layer of incandescent vapours, of relatively low temperature, which, conformably to Kirchoff's theory, produce by their absorbing power reversal of the lines of the solar spectrum. It is very probable that the vapours to which the reversal is due are not all situated in the atmosphere which Prof. Young has revealed to us, and which has a thickness of only 1000 kilometres. If it were so, absorption must be infinitely more intense at the edge of the sun than it is at the centre. Nevertheless, the borders of the sun show no trace of this abnormal absorption. The observations of M. Janssen in 1867 showed this, and it is also proved by photographs of the spectrum of the sun which I took at the annular eclipse of 1890 at Canœ in the island of Crete.

It is probable that the reversal of lines is produced in a series of layers whose total thickness is great enough to make the difference of absorption between the centre and limb of the sun inappreciable. According to Prof. Lockyer the sun should be surrounded by concentric layers of vapours arranged in order of density, which, according to his own expression, envelope the sun like "the leaves of an onion." Prof. Young's layer of vapours would comprehend only some of these layers. This hypothesis seems confirmed by the observation made by M. Trépied in 1882: although he saw "a veritable rain of bright lines in the spectrum," he proved that the coincidence of the bright and dark lines was not complete.

Prof. Lockyer's theory involves also, as another consequence, the unequal length and width of these bright lines; indeed, the layer nearest to the sun should give short lines corresponding to the thickness of this layer, and as the temperature here must be very high the lines should be rather wide. The following layer being seen by projection, and having a thickness equal to the two layers, should give lines twice as long; moreover, this second layer being cooler than the preceding the lines should be narrower. The same reasoning applies to the succeeding layers, so that we ought to find, soon after the beginning of the total eclipse, short and wide lines, then long and narrow ones. The observations of 1882 confirmed these predictions, and English astronomers wished to repeat the experiment in 1886. Unfortunately the observations of Father Perry and Mr. Turner were made under conditions too unfavourable for us to draw any certain conclusion from them. To fully elucidate the question it is necessary to obtain instantaneous photographs of these bright lines. The experiment was indeed attempted by English observers in 1883, but they seem to have obtained no result. Prof. Lockyer proposes during the approaching eclipse to photograph these lines as well as the bright lines of the corona. He intends to use not only an analytic spectroscope, but a prismatic object glass. This apparatus will give the monochromatic images of the corona, that is to say, the kind of rings corresponding to each elementary radiation emitted by the coronal light.

When we turn the spectroscope towards the corona itself we observe a continuous spectrum, crossed by a bright green line which does not belong to any known element. This line, near the line E, corresponds to the division 1474 of Kirchoff's scale, and was at first believed to coincide exactly with a line of iron; but in 1876 Prof. Young was able to separate the line 1474 with powerful dispersion, and proved that one of its two components belongs to iron while the other belongs to the coronal matter. This line 1474 has been shown in every total eclipse, but its intensity has been very variable and seems always to have followed the fluctuations of solar activity. Thus in 1878, a period of maximum spots, the green line was so faintly visible that it escaped all observers except two. On the other hand, in 1882, when the solar activity was almost at its maximum, the green line was visible to within 40′ from the limb. However, we must remember that these estimations made by different observers, observing with very dissimilar instruments, are scarcely comparable, and trustworthy evidence can only be obtained from photographs of the spectrum of the corona. The new plates sensitive to the green will no doubt allow the line 1474 to be photographed in the approaching eclipse.

It would be interesting to know whether the intensity of the green line varies with the brilliancy of the different parts of the corona, whether it is completely wanting in the rifts, whether it extends further than the visible corona, whether it has the same width in its whole extent, &c. These observations can only be made by associating with the spectroscope a telescope serving as a finder, in which cross wires have been arranged to indicate at each moment towards what part of the corona the slit is directed. The spectrum is observed with one eye while with the other the corona is examined. This is the arrangement which M. Janssen has always adopted in his spectrum observations of the corona.

If the terrestrial atmosphere is loaded with water vapour, we must expect a general diffusion of the coronal light, and this is doubtless the reason that on some occasions, as in 1870, the green line is seen beyond the corona—even upon the lunar disc.

Prof. Hastings, in 1883, examined simultaneously with a special arrangement the spectra of east and west portions of the corona, and proved, conformably to the theory that he propounds, that the green line varied in length during the duration of the eclipse, and that it always extended furthest on the most illuminated side of the edge of the moon. Mr. Keeler repeated the experiment in 1889, and also noted that the length of the green line depends upon the position of the sun with respect to the moon. The question would be worth studying further.

The green line is not the only bright line in the spectrum of the corona, the hydrogen lines have also been discovered in it, but these never extend further than about 10′ from the sun's limb. Other bright lines in the red and in the violet were observed by M. Tacchini and by Thallon in 1882. It was in 1882 also that Prof. Schuster obtained the first photograph of the coronal spectrum upon which some thirty bright lines may be counted.

In addition to the incandescent solid or liquid matter producing the spectrum of the corona, and the incandescent gases, which give rise to bright lines, there must also be in the circumsolar regions matter reflecting the light of the photosphere, as our own atmosphere does. This is proved by the polarisation of the light of the corona, and by the presence in its spectrum of the dark lines of the Fraunhofer spectrum. We owe the discovery of these dark lines to M. Janssen. In 1871 he observed only the lines D and *b*, but, since, in 1883, he has recognised some hundred dark lines, thus showing that the complete Fraunhofer spectrum is found in the coronal spectrum. These dark lines are necessarily very faint, for they are drowned in the continuous spectrum. As a rule the line D is most conspicuous, although, according to Prof. Hastings, if a faint solar spectrum is projected on to the continuous spectrum of a gas flame, it is not the line D, but rather the group *b*, which is by far the most apparent. Prof. Hastings concludes from this experiment that the continuous spectrum of the corona is richer in green than in orange radiation, since it causes the group *b* to disappear before the line D.

In conclusion I must quote a remarkable observation made by Prof. Tacchini in 1883, which, should it be confirmed, would suggest a very fascinating theory of the corona. Upon examining the spectrum of one of the sheaves (panaches) of the corona with a considerable dispersion and a wide slit, Prof. Tacchini thought he recognised two or three bright bands characteristic of the hydrocarbons, which are always present in the spectra of comets. Father Perry in 1886 proposed to verify the observation of Tacchini, but unfortunately could not re-observe the bands in question. Certainly he used a spectroscope with slightly illuminated cross wires, and when the period of great solar activity had already passed. It would be well in future eclipses to devote some seconds to the search for these bands, for, if the presence of carbon were recognised in the coronal atmosphere, it would be a new proof of the analogy which exists between the corona and cometary masses. Like comets the corona seems formed of matter subject to a repulsive force on the part of the sun, indeed it is probable that solar gravity does not act upon the corona, for unless this were so, the lower parts, having to support the weight of the upper, would be much more dense than the latter. It would thus result that the lines of the coronal spectrum, the line 1474 for instance, would be wider at their bases than at their upper extremities; but nothing of the kind has hitherto been observed. Moreover, so that the corona may be visible at 30′ or 40′ from the sun, the coronal matter must necessarily not be too rare in these extreme regions; but even in ascribing an extremely low density to this, we should find upon allowing for solar gravity that the pressure near the sun would have a considerable value, although it is proved that the pressure at the base of the corona does not exceed some millimetres of mercury.

It is also sought to prove the slight density of the middle corona by the fact that it has never offered any resistance to comets, which, on several occasions, have passed through it; but as comets themselves experience no appreciable resistance when they encounter a body it is impossible to tell whether the absence of resistance is due to the comets or to the corona.

The repulsive force which expels the coronal matter from the sun would act in the same manner as electrical force; indeed Prof. Bigelow has noticed that the arrangement of plumes and sheaves round the solar disc, and the ircurvilinear forms exactly recall the lines of force of an electric field. Let us complete the parallel between comets and the corona by noting that the tails of comets sometimes assume the curvilinear form found in the sheaves of the corona. The dark parts which divide the tails of comets have also their analogues in the rifts of the corona. To push the comparison still further, it would be very interesting to be able to prove that the corona, like cometary masses, is transparent, and that bright stars can be seen through it. Unfortunately it will be impossible to attempt this experiment at the time of the next eclipse.

An exact photometric study of the solar surface would perhaps detect the transparency of the corona, indeed if we suppose that the corona presents a certain opacity the parts of the photosphere on which the large sheaves are projected must be less luminous than the parts covered by the polar rays.

If the corona is not subject to solar gravity it is scarcely probable that it shares the movement of rotation of the sun; however, it would be useful to try in the coming eclipse to study the question by the spectroscopic method, as M. Trouvelot wished to do in 1883. It would be desirable to conduct all spectroscopic observations of the corona by means of photography. The instruments which must be used for this purpose should be very luminous (*i.e.* give bright images), for there is little light available, and the exposures are necessarily short. In studying the effectiveness of a spectroscope in the case of an object presenting a large apparent diameter, like the corona, it is seen that the intensity of the spectrum depends entirely upon the width of the slit, and the effectiveness of the object glass which forms the image of the spectrum. As to the collimator and the condenser their dimensions are of no importance, provided that the collimator can well receive all the light of the condenser. As the object glass which forms the image of the spectrum must have an image long enough to give sufficient length to the spectrum, one is led, in order to obtain great effectiveness, to give this object glass a large aperture, and consequently to use a prism of large size.

The visibility of the bright lines depending not only on their brightness, but also on their width, a wide slit must be employed to obtain a good image of these lines; on the other hand, a narrow slit will give a spectrum of great purity, and will show the dark lines. The employment of two different spectroscopes is then plainly indicated.

It remains for us to speak of the photometric measuring of the corona by optical photometers. Bunsen's photometer has already been used for this purpose, but I think that we must henceforth turn to photography to obtain exact results. The question should not be neglected, for it is certain that the brilliancy of the corona varies considerably from one eclipse to another. Thus Prof. Lockyer estimates that in 1878, at a period of quiescence on the surface of the sun, the corona was ten times less brilliant that in 1871.

Let us end by pointing to the polariscope observations which hitherto have been far from giving concordant results as to the proportion of polarised light in the various parts of the corona. Here also there are new inquiries to be made.

Such, gentlemen, are the different problems suggested by the study of the solar corona. We will hope that the next eclipse will largely contribute to their solution.

MEMORIAL OF SIR RICHARD OWEN.

A MEETING was held at the rooms of the Royal Society, on Saturday, to make preparations for the provision of a suitable memorial of the late Sir Richard Owen. The Prince of Wales took the chair, and was supported by the Duke of Teck, the President, the Treasurer, and the Secretary of the Royal Society, Lord Kelvin, Sir John Evans, and Professor Michael Foster; the President of the British Association, Sir A. Geikie; the President of the Royal College of Physicians, Sir A. Clark; the President of the Royal College of Surgeons, Mr. T. Bryant; the President of the Royal Academy, Sir F. Leighton; the Bishop of Rochester, the Dean of Westminster, Lord Playfair, Prof. Huxley, Sir H. Roscoe, M.P., Sir F. Abel, Sir F. Bramwell, Sir G. Stokes, Sir H. Acland, Sir Joseph Lister, Mr. Ericsen, Dr. Priestley, Dr. Günther, Dr. H. Woodward, Dr. Maunde Thompson, Sir W. H. Flower, Sir Erasmus Ommanney, Sir James Paget, Sir Henry Thompson, Sir Spencer Wells, Sir Edwin Saunders, Sir John Fowler,